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ABSTRACT

The use of computers to facilitate learning is yet to make an appreciable in-road into the teaching-learning process in most developing Third World countries. The purchase cost and maintenance expenses of the equipment are the major inhibiting factors related to adoption of this high technology in these countries. This study investigated: (1) the attitude of students who operate within an indigenous technology-dominated environment toward the use of the computer in learning biological concepts; (2) whether an attitude change would result when such students engaged in the use of the computer on an individual or cooperative learning basis; and (3) whether students who operate within an indigenous technology-dominated environment achieve better in biology when learning is undertaken with the use of the computer. Achievement and affective data were collected from 64 students enrolled for a 3-month Nigerian Joint Matriculation Examination in Biology. Results indicated that the interactive use of the computer resulted in significant attitude change and significantly higher scores were obtained by the group that worked together cooperatively. The results also showed that the girls in the computer-assisted group had a significantly more positive attitude towards the use of the computer as a learning tool in biology than the boys. The educational implications of these results are discussed. (Author/CW)

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ATTITUDE TO THE USE OF THE COMPUTER FOR LEARNING BIOLOGICAL CONCEPTS AND ACHIEVEMENT OF STUDENTS IN AN ENVIRONMENT DOMINATED BY INDIGENOUS TECHNOLOGY

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ABSTRACT

The use of computers to facilitate learning, a scheme that is in vogue in the developed world, is yet to make an appreciable in-road into the teaching-learning process in most developing Third World countries. The cost of purchase and maintenance is the major inhibiting factor to the adoption of this high technology in these indigenous technology-dominated countries. This study investigated (i) the attitude of students who operate within an indigenous technology-dominated environment toward the use of the computer in learning biological concepts, (ii) if an attitude change would result when such students engage in the use of the computer on an individual or cooperative learning basis; and (iii) if students who operate within an indigenous technology dominated-environment achieve better in biology when learning is undertaken with the use of the computer. Achievement and affective data were collected from 64 students enroled for a 3-month Nigerian Joint Matriculation Examination in Biology. The subjects were randomly assigned into three groups- one group learned biology on individual basis using the computer, the second learned biology on cooperative basis using the computer while the third learned biology without the use of computer. Results indicated that the interactive use of computer resulted in significant attitude change and significantly higher scores were obtained by the group which worked together cooperatively. The results also showed that the girls in the computer-assisted group had a significantly more positive attitude towards the use of the computer as a learning tool in biology than the boys. The implications of these results are discussed.

THE PROBLEM

The use of computers to facilitate learning, a scheme that is in vogue in the developed work, is yet to make an appreciable in-road into the teaching-learning process in most developing Third World countries. The cost of purchase and maintenance is the major inhibiting factor to the adoption of this high technology in these indigenous technology-dominated countries (Hasselbring, 1986; Okebukola, 1988; Jegede, Okebukola & Ajewole, 1990). As explained by Jegede, et al (1990), the technology of micro-computers is relatively new and still fairly expensive. While developed countries are in a position to adjust their economy to accommodate the expenditure on micro-computers in the classroom, the economy of many developing countries is dormant, rudimentary and only struggling to meet with the basic needs of health, rural development and general education.

The colossal cost of purchase and maintenance of computers by developing countries in detriment to more pressing needs of the ordinary citizen makes the demand for computers in science classrooms a luxury at the moment. This is comparable with the experience of China when the first computer course was introduced in 1978 (see Chen's (1988) account of the introduction of computers in Chinese secondary schools).

A second problem relates to defining the concept of computer literacy and what is demanded of computers in classrooms of developing countries. The relative inexperience with computer technology in the developing countries, the lack of well trained personnel and the inappropriateness of software developed using the western world view of learning (Wheal, 1984) demand a totally different approach to the introduction and use of computers in developing countries (Jegede, et al; 1990).

In Nigeria, the desire to join the bandwagon of countries using computers in their classrooms has made government to underplay the cost factor. Computer education and computer-assisted learning are now planned to be key elements in the implementation of the new policy on education which came into operation in 1981.

The literature on computer-assisted learning, largely within the setting of the developed countries, indicates the positive effect of the use of computers in promoting students' achievement (Choi and Gennaro, 1987; Wainwright, 1989). Questions that should be addressed next are:

(i) Will the computer equally facilitate students' learning in indigenous technology-dominated cultures characteristic of developing Third World Countries?

(ii) Is cooperative learning with computers helpful in promoting students' achievement since cost precludes computer-assisted learning on an individual basis?

Feeble attempts have been made to empirically address these questions. Yet these developing countries in Hasselbring's (1986) view are going ahead to let in computers into their classrooms'. The object of this study was to provide data on whether or not the attitude and achievement of students operating within an indigenous technology-dominated culture will be positively influenced by a computer-assisted learning programme. This will be examined within cooperative learning and individual learning settings.

Several researches have suggested that the computer holds much promise as a tool for science teachers in their classrooms (Lunetta and Hofstein, 1981). This suggestion has been endorsed by data provided by a number of studies. Choi and Gennaro (1989) for instance found that computer simulated experiences were as effective as hands-on laboratory work. Waugh (1985) on the other hand, found that microcomputer-administered diagnostic testing influenced the immediate but not the continuing achievement of students in science. Affective data collected in the study indicate that students react favourably to the use of microcomputers in diagnostic testing.

Hounshell and Hill (1989) in their study conducted in the US rejected the hypothesis of no difference in the achievement of students exposed to a computer-loaded biology course and students in a comparison group. The mean score on the Comprehension Test of Basic Skills was found to be higher for the experimental (computer-assisted) group. Leonard (1989) found that introductory biology students in his US sample who had interactive videodisk/computer lessons indicated an overall level satisfaction with the strategy. The students frequently remarked that videodisk instruction gave them more efficient use of instructional time than did the conventional lab mode. In Britain, the enhancing effect of the use of the computer on students' learning or scientific concepts has also been demonstrated (Barnes, 1988).

Three specific questions were focussed upon in the present study. These were:

1. What is the attitude of students who operate within an environment that predominates in indigenous technology toward the sue of the computer in learning biological concepts?
2. Will there be an attitude change when such students are engaged in the use of the computer on an individual or a cooperative learning basis?
3. Will students who live in an environment that is dominated by indigenous technology achieve better in biology when learning is undertaken with the use of the computer?

METHODOLOGY

Sample

The participants in the study were all the 64 students enroled for a course preparatory to the Nigerian Joint Matriculation Examination in Biology. There were 41 boys and 23 girls in the sample with a mean age of 16 years and 4 months. The students were adjudged by Ikoku's (1989) definition to be from environments that are dominated by indigenous technology.

Instrumentation

Attitude to the use of the computer for learning biological concepts was measured using a 20-item instrument on 5-point Likert scale. The items (ten positive and ten negative) were judged by a jury of experts as validly testing the construct of interest. It contained statements such as "Using computers in a biology class will make biology more fun", and "Biology is a study of life, non-living objects like computers should not be used for teaching it". The coefficient alpha for the 20 items was 0.96.

Data on achievement were obtained using a 40-item multiple-choice test. Items were drawn on the topics presented in the computer lessons. The KR20 reliability value of 0.89 was recorded for the achievement test instrument.

Procedure

All the 64 students took the attitude and achievement tests shortly after enroling for a 3-month Joint Matriculation Examination preparatory course. They were then divided into three groups. One group of 10 (6 boys, 4 girls) used the computer on an individual basis. Another group of thirty worked in ten 3-member cooperative learning teams. There was a girl in each team. The third group of 24 (15 boys, 9 girls) did not use the computer. They were taught the biological concepts by the second author. Group assignment was done on a random basis.

The software used was the School Software BIO 101 with the following eight topics in the main menu: (1) Life and Cells; (2) Mammals and Plants; (3) Photosynthesis and Enzymes; (4) Respiration and Excretion; (5) Transport and Osmosis; (6) Sensitivity and Coordination; (7) Reproduction; (8) Cycles and Micro-organisms. Students in the first group worked individually on the computers. They read the computer texts, responded to the questions and were rewarded individually.

In the 3-member cooperative learning teams, the students read the text together, took turns in responding to the questions and accepted the reward as a team. The third group which acted as the control was taught in a whole class using the lecture-demonstration method. The study lasted for three months after which all the subjects took the attitude and achievement tests.

RESULTS

When submitted to an ANOVA, the pretest scores generated an F-ratio of 0.69 ($p > .05$) for attitude and 1.03 ($p > .05$) for achievement leading to a verdict of group equivalence on the dependent measures.

The mean attitude pretest score for the three groups were: 35.03 for the control; 34.93 and 35.11 for the individual and cooperative groups respectively. Since the range of scores for this measure is 0-100, it was concluded that the subjects in the sample, taken together, did not have a positive attitude towards the use of the computer for learning biological concepts. This provided an answer for our first research question.

A Group X Gender ANOVA was then conducted on the posttest scores for attitude. This yielded a significant main effect for group ($F(2, 61) = 39.86$, $p < .0001$) but not for gender ($F(1, 62) = 0.89$, $p > .05$). For achievement in biology, no significant F-values were recorded for the two main effects.

A more illuminating perspective of these results is provided in Table 1 which reports the posttest means for the groups on attitude.

Table I here

Table 1 shows that the students who used the computer in a cooperative learning setting had the greatest attitude change followed by students who worked individually on the computer. The control group students who did not use the computer had the least mean posttest score on attitude. When compared, a significant difference was found between the pre and posttest scored of the experimental group students.

With respect to achievement, the mean posttest scores of the three groups are shown in Table II.

Table II here

On this measure, the computer-assisted group was not better than the control. The F-test revealed no significant difference between the individual, cooperative and control group students. An inspection of the means in Table II however shows that the cooperative group students recorded the highest mean score of all.

DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

We found in this study that at the pretest level, the students in the sample did not have a favourable attitude toward the use of the computer for learning biological concepts. Using the computer however, resulted in significant attitude change.

The posttest results presented in Table I further indicate that the group of students who interactively used the computer had a more favourable attitude towards the sue of the computer in learning biological concepts than students who had no such opportunity. Further support is provided for previous literature that reports attitudinal improvement towards computer-assisted learning as a result of the use of the computer (Leonard, 1989; Shaw, 1985).

The improved attitude of experimental group students toward the use of the computer could be due to the captivating nature of the question and answer sessions provided by the computer (Okebukola, 1989). This situation might have been made prominent by the indigenous technology-dominated environment from where the students were drawn. The level at which computer operations could "dazzle" a user in this kind of environment is likely to be particularly high.

Also worthy of note in the result reported in Table I is the highest score on attitude was recorded by students who worked together cooperatively. The facilitative nature of cooperative learning on students' attitude has also been reported by a number of previous workers (e.g. Okebukola, 1985; 1986; 1987; Sherman, 1989). The implication of this finding with respect to the use of the computer where funds for the purchase of computer hard and software are scarce is obvious. Its cost precludes the purchase of many computer units, students can work cooperatively on the few units available. The limitations of this kind of arrangement especially when the group is large and uncontrollable is not lost sight of. Perhaps future studies could address the issue of critical group size that can derive maximum benefit from the use of the computer on a cooperative basis.

With respect to achievement, our data did not support previous literature (e.g. Choi and Gennaro, 1987; Wainwright, 1989) indicating that students learn better with the computer. The finding is however in agreement with the few studies that have found no difference in the achievement profiles of students taught using the computer and those who were taught without the computer (see for example Waugh, 1985). Our guess at this stage is that the students who used the computer and who were used to indigenous technology, were so carried away with the wonder machine that they did not really settle down to grasp the concepts the computer was teaching them It may also well be that computer-assisted learning is not superior to the "traditional" method of instruction in promoting students' achievement. Our expectation however is that after a period of adjustment, students from the indigenous technology-dominated environment will get used to the computer and

learn from it more than they would learn from teacher lectures. A follow-up study to test this hypothesis is currently underway.

Very firm conclusions cannot be drawn from the results of this study until studies in similar settings provide confirmatory data. The results are however indicative of the fact that the computer has the capability of exciting students in an indigenous technology-dominated environment. It may not bring about remarkable and significant gains in achievement when compared with the teaching methods in regular use in these settings. Perhaps when greater familiarity is established with computer usage the story may be different.

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Table I

Means, S.D. and F-Test on Attitude toward Computer usage Posttest Scores

GROUP	N	Mean	S.D.	F
INDIVIDUAL	10	61.36	12.99	
COOPERATIVE	30	79.41	14.09	39.86 **
CONTROL	24	36.09	9.24	

** $p < .001$

Table II

Means, S.D. and F-Test on Biology Achievement Posttest Scores

GROUP	N	Mean	S.D.	F
INDIVIDUAL	10	24.13	5.25	
COOPERATIVE	30	26.19	5.08	1.02 (ns)
CONTROL	24	25.23	6.29	

ns = not significant

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